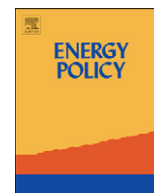


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## Communication

# Assessment of utilization of wind energy resources in Nigeria

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## ABSTRACT

The study critically reviews the prospects and challenges of utilizing wind energy resources for power generation in Nigeria. The various initiatives by governments and researchers were surveyed and the nation is found to sit in the midst of enormous potential for wind harvest for power generation. The far northern states, the mountainous regions and different places of the central and south-eastern states were identified as good areas for wind harvest together with the offshore areas spanning from Lagos through Ondo, Ogun, Cross-Rivers to Rivers states along the Atlantic Ocean in the south–south. Despite this great potential and huge prospect, the country is found to still suffer from serious energy crises due to her over dependence on hydropower which also is susceptible to seasonal variation in the amount of water levels at dams. There is yet to be committed wind energy project for power generation on-going in the country. Several challenges bedeviling the development and utilization of wind energy resources were identified and suggestions highlighted to help pull the nation out of this lingering energy crisis.

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## 1. Introduction

Energy has been defined as the ability to do work (Tippen, 2001), a force multiplier that enhances man's ability to convert raw materials into useful products, providing varieties of useful services (Sorensen, 1983; Ridao et al., 2007). It is of different kinds and forms with broad division under the renewable and non-renewable energy sources. The most widely used has been the non-renewable, which also have been described as not too friendly to the environment, because of its harmful emissions and byproducts (Hermann, 2001; El Bassam and Maegaard, 2004). Such examples include the use of coal, fossil fuels and nuclear reactors. These sources are depletable, and do not produce adequate and consistent power for national consumption, even the cost of maintenance has never been of help for developing nations. More so, the energy needs of developing countries like those of Africa are increasingly growing, more than one out of three people were reported to depend on traditional biomass for cooking and heating (United Nations, 2005); an International projection reported that the energy dependence of the world is expected to rise by over 34% between 2002 and 2025 when that by developing nations only, is expected to double the present demand (U.S. department of Energy, 2005). Thus, bringing about growing concerns in creating alternative energy sources which will be capable of meeting the energy needs of the world's

population, as those of the present sources and usage is unsustainable and unsuitable.

Energy development in Nigeria has over the years been through many challenging tasks. The incessant power outages have contributed severely to the lingering poverty crises in the nation, with many business outfits relying on alternative uses of diesel and petrol generators to run their machines, contributing to the emission of greenhouse gases and air pollutants thus, creating global warming concerns and also increasing cost of production. The inconsistency in power supply is mainly due to the nation's dependence on hydropower, which is seasonally dependent. Moreover, the seasonality of this source has made the amount of water available at different power stations variable, thereby making recurrent cut in power supply inevitable. This erratic nature of power supply has caused the economy to nosedive, proving that unless she looks for complementary alternative means of power supply for her growing population, the nation stand a risk.

The way out of this, lie in the use of renewable sources of energy for power generation, as they contain enormous, largely untapped and sustained opportunity for meeting the world's energy needs, they are environmentally friendly as they do not contribute harmful and toxic emission to it. In addition, they do not create the concern of eventual depletion as those of non-renewable sources; for example, the sun radiates enormous amount of energy in one year than people have used since the world began (Ajayi, 2007). Another example of renewable sources of energy is the wind energy; it is one of the cleanest and most environmentally friendly sources of energy, capable of generating a high amount of electricity. The focus of this work is to critically

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review the prospects and challenges of utilizing wind energy resources in Nigeria for power generation with a view to proffering solution, which can serve as a way out of the situation.

## 2. Prospects and challenges of wind energy utilization in Nigeria

### 2.1. Prospects

The utility of wind as a resource for energy and power generation in Nigeria is a thing slowly gaining ground and attracting government's attention. Presently, the country is only in the developmental stages of policy generation, as there is still no physical presence of working wind energy resources for power generation within the country, what is available are relics pointing to the fact that wind has been used in time past to drive water pumps. However, the realization of the need to have adequate and sustainable energy development program for power generation in the country over these few years had prompted some government initiatives to look into the potentialities of wind as a means for power generation. Such initiatives include that by the joint Energy Commission of Nigeria (ECN) and the United Nations Development Programme (UNDP) on one hand, and the Federal Ministry of Science and Technology (FMST) on the other hand, both in 2005. That by the ECN and UNDP appointed a group of consultants to look into the energy situation of the country with a view to proffering solution and raise suggestions to move the nation out of crises. While that by the FMST, appointed an international wind energy consultant, Lehmeier (International) Consultants, to look into the same situation, but this time with a view to assessing the capabilities for wind energy utilization and thereby carryout a wind power mapping of the nation. Their reports are available (ECN-UNDP, 2005; Lehmeier (International) Consultants, 2005).

According to the report of Lehmeier (International) Consultants (2005), wind energy reserve in Nigeria at 10 m height reveals that some sites have wind regime between 1.0 and 5.1 m/s, and show that Nigeria falls into the poor/moderate wind regime. It was also reported that wind speeds in the country are generally weak in the south except for the coastal regions and offshore, which are windy. Offshore areas from Lagos through Ondo, Delta, Rivers, Bayelsa to Akwa Ibom States was reported to have potentialities for harvesting strong wind energy throughout the year. Inland, the wind is reported strongest in the hilly regions of the North, while the mountainous terrains of the middle belt and northern fringes demonstrate high potential for great wind energy harvest. It was, however, observed that due to varying topography and roughness of the country, large differences may exist within the same locality. The values for the wind speeds range from a low 1.4 to 3.0 m/s in the southern areas and 4.0–5.12 m/s in the extreme North, at 10 m height. Peak wind speed was shown to generally occur between April and August for most sites in the analysis.

Moreover, many indigenous researchers have also variously looked into wind energy availability in Nigeria with a view to establishing if there is likelihood for its utilization. Adekoya and Adewale (1992), analyzed wind speed data of 30 stations in Nigeria, determining the annual mean wind speeds and power flux densities to vary from 1.5–4.1 m/s to 5.7–22.5 W/m<sup>2</sup>, respectively; Fagbenle and Karayiannis (1994) on the other hand, did an analysis of 10-years wind data from 1979–1988, considering the surface and upper winds as well as the maximum gusts, Ngala et al. (2007) did a statistical analysis of wind energy potential in Maiduguri, Borno State, using the weibull distribution and 10 yr (1995–2004) wind data. Cost benefit analysis were also carried out using the wind energy conversion systems for electric power generation and supply in the State; while Bugaje (2006)

reviewed the renewable energy usage in Africa using Nigeria, South Africa, Egypt and Mali as case studies, the various energy policies of these countries were also looked into and consideration was given to the energy crises of the continent, pointing out the need to discourage the use of wood and related traditional biomass to focus on environmental preservation and use of clean energy sources.

Another report by Ajayi (2007), on the modeling and simulation of wind energy potential of Nigeria, in which analysis was carried out on 10 years (1990–1999) wind data assessed from the Nigeria Meteorological department, Oshodi, Lagos, South-West, Nigeria for ten states cutting across the five geo-political zones of the federation with a station per state and two states per zone also revealed that the rank of potential for annual wind energy flux density for the nation is in the order: North, Central, South-East, South-South and South-West zones, respectively, with the first three zones of the rank contributing about 86% of the total energy as calculated from the findings.

Each of these reports points to the fact that the nation is blessed with vast opportunity for harvesting wind for electricity production, most especially at the core northern states, mountainous parts of the central and eastern states and also offshore areas where wind is abundantly available throughout the year, if the attendant challenges can be overcome. The issue then is for the country to look at ways of harnessing resources towards settling up wind farms in various regions and zones that have been identified as possessing abilities for wind energy harvest. More so, wind energy had been shown to peak between November and March when the weather condition is generally dry, with extent of rainfall at the North and South-South zones being 0 and 75 mm, respectively, and drops considerably between June and October when the weather condition is wet, with the least across the nation being at October when the extent of rainfall at the North and South-South zones are around 75 and 500 mm, respectively. The rainfall levels at the other zones falling in between the two values of the North and South-South zones (Longman Nigeria PLC, 2000; Ajayi, 2007). Fig. 1 below is a map of Nigeria showing the average topography measures and prevailing winds across the geo-political zones of the federation. Thus, making wind energy a sure compliment to hydropower in the country.

### 2.2. Challenges

Wind energy utilization in Nigeria is minimal, hundreds of wind pumps scattered around the country are ill maintained and some abandoned. The development of wind technology and utilization of wind resources by the growing population is being bedeviled by series of limitations, which include:

#### 2.2.1. Low financing

The government in its bid to rid the country of her energy crises must appropriately create and finance wind centers and technologies; Research and Development tailored towards wind technology advancement must also begin and be adequately financed by both private and public establishments; focus must be given to establishing wind farms across states with high potential for wind energy cultivation. To achieve these much resources need be committed towards this viable option. The present attitude of government must change, not much wind research are on-going across the country, the state and federal budgets contain no quota towards advancing wind technology and other renewable energies. The idea of allocating tiny percentage of the federal budget to the broad sector of science and technology ministry is unsuitable; certain specific amount must yearly be allocated towards wind technology and other renewable energies.

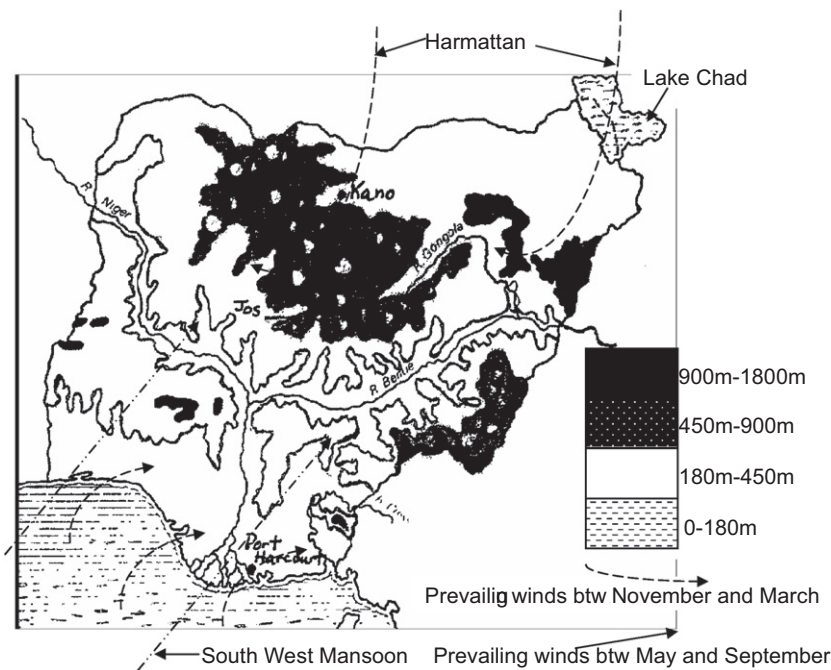


Fig. 1. Map of Nigeria showing relief and prevailing winds.

#### 2.2.2. Reluctance of governments and its agents to encourage wind technologies

The government has thus far not done anything to encourage wind energy utilization in Nigeria. The various initiatives have not been evaluated with the sole aim of creating appropriate administrations to look into ways of establishing wind farms and utilize wind technologies. As at today, no foreign or indigenous wind energy vendors are available in the country, both federal, states and local governments must rise up and give economic incentives to willing private investors; there are presently no tax reduction/elimination, no promissory notes and no policy on reduction/elimination of duty payable on wind technology importation.

#### 2.2.3. Lack of awareness

The community of people within the nation lack existing knowledge bases that promote the use of wind energy and other renewable energies through economically and financially sustainable models. There is a dearth of knowledge on the market potentials of wind energy and other renewable energies, even the schools' curriculum lack adequate expository information on wind and other renewable sources, the technology, potentialities and their environmental situations. The mass media too has not helped in any way, hardly information regarding wind energy utilization or technology can be seen on the pages of newspaper or heard discussed on television or radio.

#### 2.2.4. Technical ineptitude

The majority of the people of Nigeria does not have access to renewable energy technologies like those of wind and thus may not understand them; despite the opportunities for it in the nation, the lack of the technical-know has hindered its advancement and adoption and subsequently its growth.

### 3. Strategies to encourage wind energy utilization

Identifying the various opportunities for wind energy resources in the country, there are strategies that must be put in place to

encourage its utilization and further developments, of these include leveling the playing field in the energy market; the government in time past subsidizes prices of fossil fuels, bringing about their increased demand and negatively impacting on the growth of wind energy technology and other renewable energy sources in the nation. For wind energy resources to widely be accepted, there must be a level playing field between it and other sources of energy currently in use. This will involve the removal of subsidies from the sale of fossil fuels, focusing on the developments of wind farms and technologies, creating sustainable markets for the sale of wind energy; others include provision of interest free and low-interest loans for financing wind energy projects, establishing strong institutional leadership for wind energy advancement (ECN-UNDP, 2005), developments and maintenance of wind farms in areas of high potentialities, creating increasing awareness about the importance of wind energy resources, establishing strong national research and development policy for wind energy technology development, adequately financing wind energy projects, removal/reduction of custom duties on imported wind energy technology, and creation of innovative incentives to encourage development of wind energy technology.

### 4. Conclusion

A critical review of prospects and challenges facing the utilization of wind energy resources for power generation in Nigeria has been carried out. The various indices which represent huge prospects for wind energy utilization for electricity production in the country were surveyed. It was discovered that though wind energy availability in the south-western and south-southern parts of the country is very poor, offshore areas bounded by the Atlantic Ocean and running from the south-west coast through south-east to the south-south have enormous potential for wind energy cultivation for power generation. Also, the interchangeability in the period of availability of wind energy and hydropower source makes wind energy a good complement for power generation, when the water levels at the hydropower stations are low. More so, the far northern states and mountainous areas of

the central and eastern zones of the country possess a huge amount of wind energy, capable of producing about 86% of the possible total annual wind energy flux density for the country. These represent a huge prospect for wind energy utilization if the attending challenges bedeviling the development of wind energy resources for power generation are overcome. These challenges have been found to vary from the lack of awareness to technical ineptitude, thus, bringing about a need for the government of the country at all levels to look into ways of surmounting these and other challenges, create enabling environment to attract both local and foreign investors and also develop sites for wind farms and wind power utilization. When this is done, the result will then be that the energy situation of Nigeria will be on the way out of its critical state, having more options of energy production instead of her over dependence on hydropower.

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